Development of Digital Micromirror Devices for Far-UV Applications

Completed Technology Project (2018 - 2019)

Project Introduction

We propose to develop commercially available digital micromirror devices (DMDs) for use in the far ultraviolet (FUV) and near ultraviolet (NUV) regimes of 100 nm – 400 nm, using recently developed FUV mirror coatings. DMDs can be used as rapidly reconfigurable "slit mask" object-selectors in space-based UV multi object spectrometers (MOS). Currently, DMDs are the only alternative to microshutter arrays, which were developed for the infrared MOS on the James Webb Space Telescope. The need for an efficient UV MOS has been identified as a Priority 1 Technological Gap by the general community, according to the Cosmic Origins 2016 Program Annual Technology Report. There are several missions currently in the planning process, which are developing concepts for multi-object spectrometers. For example both LUVOIR and HabEx plan to include such an instrument, working into the UV. Several smaller dedicated spectroscopic survey missions based around a highly multiplexed spectrometer have also been proposed. The choice of slit selector for such instruments is limited. While microshutter arrays are currently viewed as the frontrunner, the previous generation of microshutters has limitations and the next generation is still in early development. We have worked extensively on space qualification of the Texas Instruments DMDs and have shown the current generation of these devices to be ideal for space applications. However the deep UV (100 nm -300 nm) reflectivity of such devices needs to be substantially higher. We will re-coat commercially available DMDs (which use aluminum alloy mirrors) with high reflectivity aluminum, which is protected by an overcoat using recently developed FUV-enhanced thin films (LiF and AlF3). These protected aluminum coatings were developed to have a high reflectivity in the FUV range of 100 nm – 300 nm by two recent SAT projects. This work will build on our own previous SAT-funded efforts to determine the usability of DMDs in space and to extend their use into the NUV range of 200 nm – 400 nm. As part of this work we will produce re-coated DMDs with a high reflectivity in the FUV (with and without a protective window) and investigate the susceptibility of these devices to damage due to long exposures to highly energetic FUV photons. DMDs that operate in the FUV range will provide an alternative to microshutter arrays and help close a critical technology gap in FUV/NUV astronomy.

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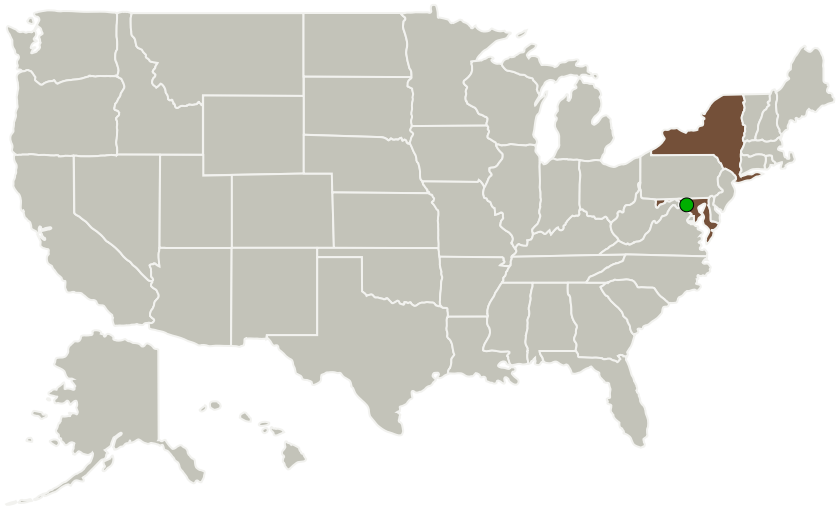
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Rochester Institute of Technology(RIT)	Lead Organization	Academia	Rochester, New York
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
Johns Hopkins University	Supporting Organization	Academia	Baltimore, Maryland
National Institute of Standards and Technology(NIST)	Supporting Organization	US Government	Boulder, Colorado

Primary U.S. Work Locations	
Maryland	New York

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

Rochester Institute of Technology (RIT)

Responsible Program:

Strategic Astrophysics Technology

Project Management

Program Director:

Mario R Perez

Program Manager:

Mario R Perez

Principal Investigator:

Zoran Ninkov

Co-Investigators:

Manuel A Quijada
Stephen A Smee
David Harrison
Alan D Raisanen
Anton Travinsky
Uwe Arp
Dmitry Vorobiev

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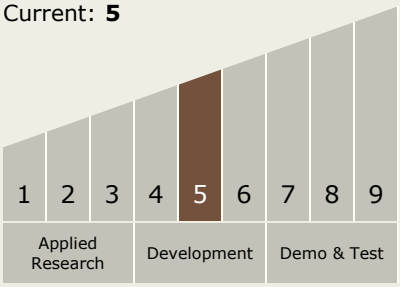
Technology Maturity (TRL)

Start: **5**
Current: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System